AMATEUR WORK

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WIRELESS TELEGRAPHY APPARATUS.

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II. RECEIVING INSTRUMENTS.

For detecting the messages that are sent out by the apparatus described in the last article, we will have to build a set of receiving instruments consisting of the well-known telegraph sounder, and relay of 250 or more ohms resistance. The higher the resistance of the relay the more sensitive the apparatus. In addition to these we must make what is known as a coherer and decoherer. The coherer is simple in construction, and based upon the property the electrical waves have of causing loose particles of iron filings to attach themselves together, somewhat similar to the action of iron filings when magnetized.

From a glass tube of about $\frac{1}{8}''$ bore and medium thick walls, cut a piece 2″ long. This can easily be done by scratching the tube at the proper place with a file, and then applying pressure on each side of the scratch by holding it firmly in the hands with the two thumbs just opposite the scratch, and boldly pressing the tube over them.

From a piece of round brass rod cut or turn two little plugs about $\frac{3}{8}''$ long and of a diameter to snugly fit the hole in the glass tube. Brass rods can easily be cut with a hack-saw. To one end of each plug solder the eye of a long, slim needle, first breaking off or blunting the points, to avoid pricking the fingers.

A small hole can be drilled in one end of each plug, to facilitate soldering of the needle. Obtain two double binding-posts and mount them on a baseboard 7″ long, 5″ wide and $\frac{3}{4}''$ thick. They should be placed 1″ from one side of the board, $2\frac{1}{2}''$ apart and $2\frac{1}{2}''$ from one end, as shown in Fig. 1. Have the holes facing each other, so that the needles passing through them will enter the glass tube and hold it firmly. Before putting the plugs into the tube make a small quantity of rather coarse iron filings by forcibly filing a piece of clean, dry iron with a coarse cross-cut file which is perfectly clean and dry. These filings are to be placed in the glass tube between the two

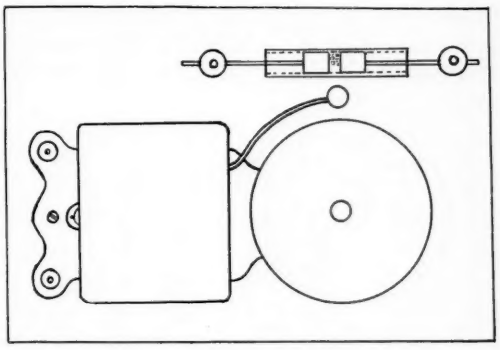


Fig. 3.

brass plugs, care being taken not to get too large an amount, and to avoid handling them with the fingers or squeezing them between the brass plugs.

The best way to get the filings into the tube is to make them over a clean piece of paper with a fold across it, so the filings can easily be poured into the tube. The plugs should be from $\frac{1}{16}''$ to $\frac{1}{8}''$ apart, and the space between them not over half full of filings. A rubber band on the

outside of the tube, where the hammer of the bell rests, will prevent breakage from too heavy a stroke of the bell.

The decoherer, as its name implies, is an instrument to counteract the work done by the coherer; that is, it destroys the coherence or clinging together of the filings which follow the passage of the wave impulses. This is accomplished by shaking the filings in the tube; and an excellent decoherer is obtained by mounting an electric bell (any box bells which work well will answer) on the baseboard so that the hammer of the bell, when at rest, lays against the glass tube of the coherer, as shown in Fig. 3.

I should advise the student or amateur to purchase the relay of some reliable firm. It should be of at least 250 ohms resistance; and 500 or 1,000 will work better and receive at greater distance. But as a relay of such high resistance is rather expensive, the reader may obtain a cheap instrument of low resistance, and rewind it with finer wire. The size and amount of wire necessary for rewinding can easily be estimated by weighing the wire taken off of the coil, and looking up in a wire resistance table the size of wire having a resistance of 500 ohms or more for the same weight of wire. For most purposes the No. 36 gauge wire used in winding the induction coil described in the last paper will be found to work well.

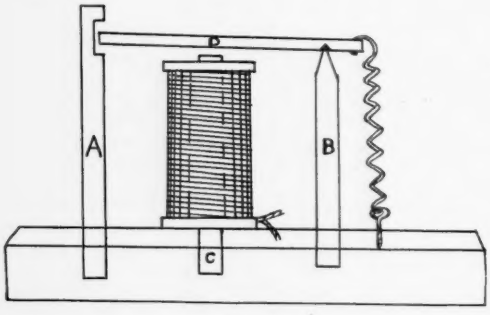


FIG. 4.

The sounder may also be purchased, but a simple one may be made as follows: Two upright brass posts $\frac{1}{4}''$ diameter (see Fig. 4), A being $2\frac{3}{4}''$ long and B $2\frac{1}{4}''$ long, are driven into the base board $2\frac{3}{16}''$ apart. Post A has a notch $\frac{1}{4}''$ long filed $\frac{1}{8}''$ from the top; B is filed wedge-shaped, as shown. Post C is of soft iron $\frac{1}{4}''$ in diameter and $2\frac{1}{4}''$ long, and is driven into the base exactly in the center, between the other two posts. The wooden base is $4'' \times 5''$ and $\frac{3}{4}''$ thick, $\frac{1}{4}''$ holes being bored in it for the posts. A selenoid, which is simply a paper or wooden spool wound with ten or twelve layers of No. 26 cotton-covered magnet wire, should be slipped over the iron center post. An iron lever, D, $\frac{1}{8}''$ thick, $\frac{3}{8}''$ wide and $2\frac{3}{4}''$ long, having a notch filed $\frac{3}{8}''$ from one end, should be placed over the coil, so that when the wedge-shaped post supports the notch in the lever, the other end of the lever should be free to move in the slot in post A. A small brass spring, made by winding thin brass wire around a wire nail, should be fastened to the base and to a hole in the short end of the lever, so as to hold the latter up against the top of the notch in A.

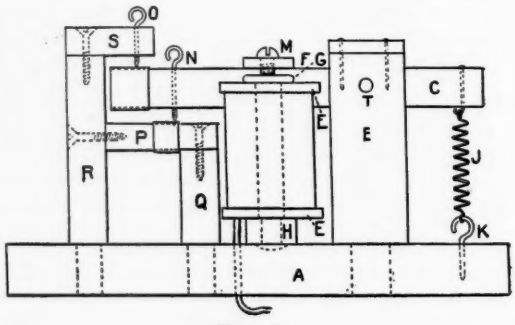


FIG. 5.

The iron post of the coil should be driven into the base until the top is a trifle lower than the notch in the post A. The top of post B should be $\frac{1}{16}''$ higher than the iron post. A more elaborate sounder is described in the November, 1901, number of AMATEUR WORK, the construction being plainly indicated by Figs. 5 and 6.

The instruments are connected as shown in Fig. 7. The coherer should be put in series with the relay and a battery of one cell. The decoherer and sounder are to be placed in multiple and then in series, with the local side of the relay and a battery of six or eight cells. One side of the coherer must be connected to the earth and the other side to an elevated wire.

For those not acquainted with the terms series and multiple, the following directions are given for making the various connections. One side of

a cell of battery should be connected by wire *a* to one of the posts of the coherer. The other post of the coherer should be connected by *b* to one end of the coil of the relay; the other end of the relay coil should be connected by *c* to the other pole of the battery. One post on the decoherer bell should be connected by wire *m* to one post on the local side of relay; the other post on local side of relay connect by wire *n* to one side of a battery of six or eight cells connected in series; i.e., the zinc on

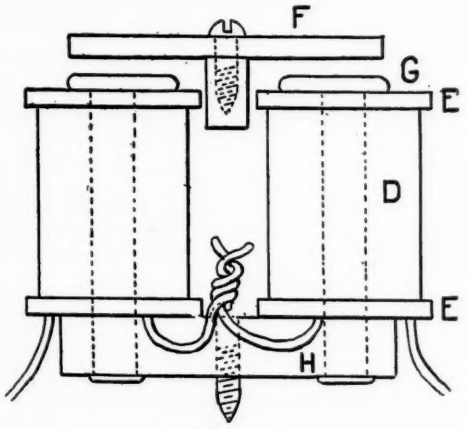


FIG. 6.

one battery connected with the carbon of another. The other side of the battery is connected by *o* to the other post on decoherer (bell). The sounder should be connected to the two posts on the decoherer by wires *f* and *p* or to the wires *m* and *o*, as may be most convenient.

The elevated or receiving wire should be as straight as possible. Galvanized iron telephone wire will answer. A pole or kite may be used to secure the necessary elevation; the higher the terminal end the greater the distance over which signals may be transmitted. Elevated places with sharp slopes are preferable for land operations. Over water height is desirable, but not so necessary. The ground wire should connect to an adjacent water-pipe, though it is better to have a direct wire connection with a copper plate buried deep enough to be in earth, which is always damp. If the instruments are to remain in connection for any length of time during the season of thunder-storms, a lightning arrester should be connected between the elevated wire and the ground wire at the point where they both enter the building, the wiring being arranged to allow this. The ground wire in this case should be as large as No. 6 gauge galvanized iron.

Choking coils have not been included in the apparatus here described, but they may be added if desired. According to some experimenters, they increase the sensitiveness of the instruments. They are made by filling a small glass or rubber tube say 1″ long and $\frac{1}{8}$″ inside diameter, full of pieces of very fine iron wire, and then winding on the outside of the tube two layers of No. 36 cotton-covered magnet wire, coating the layers with shellac to hold them in place. The ends of the outside wire are connected in series with the wire connecting the coherer and relay.

When all the apparatus is completed and the various connections made, a trial may be made to see if it will work over a short distance. The coherer, sounder and relay should "click" when a common electric bell is rung within two or three feet of them. Some adjusting will undoubtedly

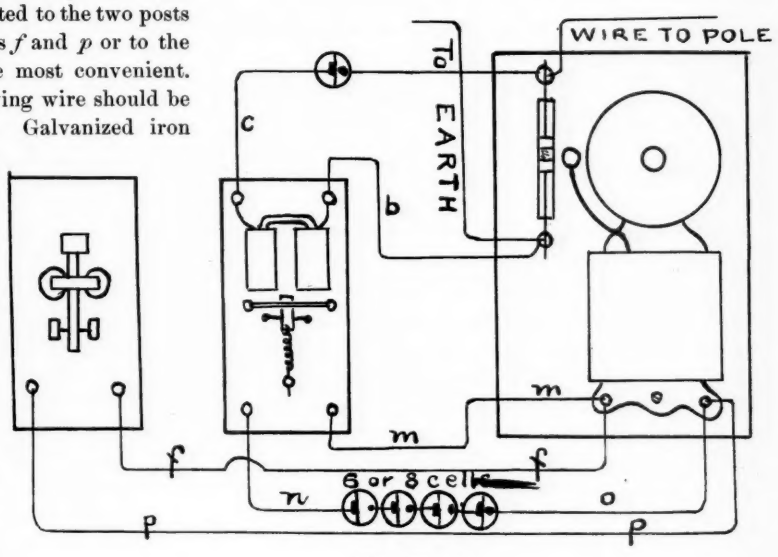
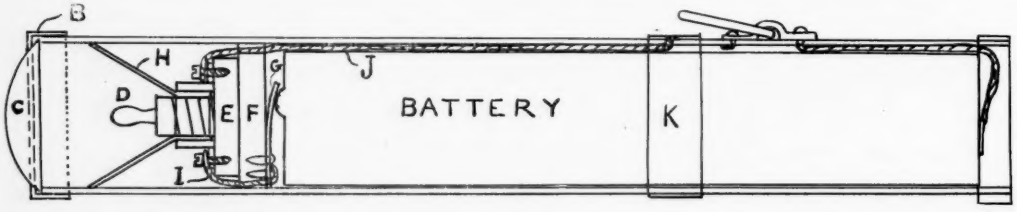


FIG. 7.

be necessary before satisfactory results are obtained. This is true of the most expensive and delicate outfits, so we should not expect this apparatus to be an exception. Tap the coherer, to see that the filings are not packed. The relay must be adjusted very delicately, the armature as close to the poles as possible, yet not touching them. The spring should be adjusted so the tension will be sufficient, but not too strong. If the bell continues to ring after a signal, either the hammer does not strike hard enough to decohere the filings, or the armature of relay needs adjusting. The battery between coherer and relay may also be wrongly connected. A little experimenting will, however, soon get the parts into working order, and then longer distances can be attempted. One important point should always be kept in mind: Never let the spark from the coil pass through the coherer. The filings in the coherer will need renewing at intervals.

AN ELECTRIC FLASH TORCH.

THE electric flash torch here described is easily made at an expense of about $1.00. The materials required are a miniature lamp of three or four candle-power, with porcelain base; dry battery for same; a piece of strong pasteboard mailing tube 9½″ long and 1½″ diameter; a piece of zinc for reflector; a cheap plano-convex lens 1½″ in diameter—although this is not absolutely necessary; a shipping case for No. 12 size works of a watch, with glass top and bottom, to be obtained from any large jeweler for the asking; a little annunciator wire, screws, etc.



The shipping case for watch-works above mentioned is used by manufacturers in sending out the works to retailers, who have no further use for them, and will undoubtedly give one to any customer who asks for it. The size used for No. 12 works is just right for the torch here described. This is mentioned as, if obtainable, a more finished appearance is the result, but the cover of a round spice-box may be cut out and will answer about as well. It is used for the end, and holds the lens C in position, as shown at B, in the illustration. The lamp D should be so located that the outer end will be about ⅜″ from the inner side of the lens. To a round piece of wood, F, ¼″ thick, fasten the porcelain base, E, of the lamp by screws. Two small holes are bored through this wooden piece for the wire connections I and J. When completed, three round-head screws are put through from the outside to hold it firmly in place.

The reflector, H, is a cone-shaped piece of bright tin, held in position by projections at the base that fit tightly between the outside of the screw socket of the lamp and the porcelain base. It should be brightly polished on the inside, but need not be soldered at the joint. It is easily cut out of thin sheet tin with metal shears, if a cardboard pattern is previously made. An examination of the illustration in connection with the lamp and socket will make this clear.

On the inner side of the piece F, attach with brads a piece of spring brass 1″ long and ⅜″ wide, and connect with the wire from one of the terminals of the lamp. The inner end of the spring should be bent so that, when the battery is in place, it will be in firm and constant contact with a small projection forming one terminal of the battery. The other terminal of the lamp is connected by wire with a thin metal ring, K, around

the outside of the tube, a hole being put through the tube for that purpose. The metal ring may be made of a thin strip of zinc or brass ½″ wide, and should be located about 3″ from the rear end of the tube. A small curtain pull, L, is attached to the outside of the tube, which when pressed forward will rest on the ring K, and complete the circuit required to light the lamp. A piece of wire connects the ring L with the base of battery, the battery end being bare and resting loosely between the zinc end of battery and the metal end of the tube, the latter being made from the cover of a round spice-box of suitable size to tightly fit the end of the tube. If such a cover cannot be secured, a round piece of wood may be cut out and held in place by three screws, the paper tube being made enough longer to receive it. Care should be taken to see that the battery makes a good contact with the spring G and with the wire connecting with the ring L.

When completed, the outside of the tube may be covered with dark-colored paper or leatherette. This torch is not suitable for continued lighting, but is intended for service requiring light only at intervals. It is a very handy device for use about the house or on the street at night when a light is needed for temporary use. In time, depending upon the extent it is used, the battery will give out, and is then replaced with a new one at a cost of about 30 cents.

THE WHEATSTONE BRIDGE.

For rapid and accurate comparison of known with unknown resistances of various lengths of wire, lamps, etc., an instrument known as a "Wheatstone bridge" is employed. It was invented by Christie, but has received the name of the more widely known scientist. As it is easily made, and of much value in electrical experimental work, many readers of this magazine will be interested to learn how it is constructed and used.

The materials required are: A piece of well-seasoned hard wood, 41″ long, 6″ wide and ⅞″ thick; one piece of brass rod 37″ long, ½″ wide and ⅜″ thick, and two similiar pieces 5″ long; 10 binding-posts with screw points; a piece of German silver wire, No. 26 gauge, 45″ long, and a small piece of brass for a pointer. It is quite important that the wire be of perfectly uniform gauge throughout, and without kinks or nicks.

The illustration shows the arrangement of the pieces of brass and binding-posts. Holes are drilled in the brass pieces large enough for the screw points of the binding-posts. The end brass pieces B′ and B″ are then carefully located, so that the space between the binding-posts C and C′ will measure exactly one meter. This in English measure is a trifle less than 39⅜″. The binding-posts C and C′ are then screwed down and the remaining binding-posts placed, thus fastening the brass pieces to the base. A space 1″ wide is left between the ends of B and the sides of B′ and B″.

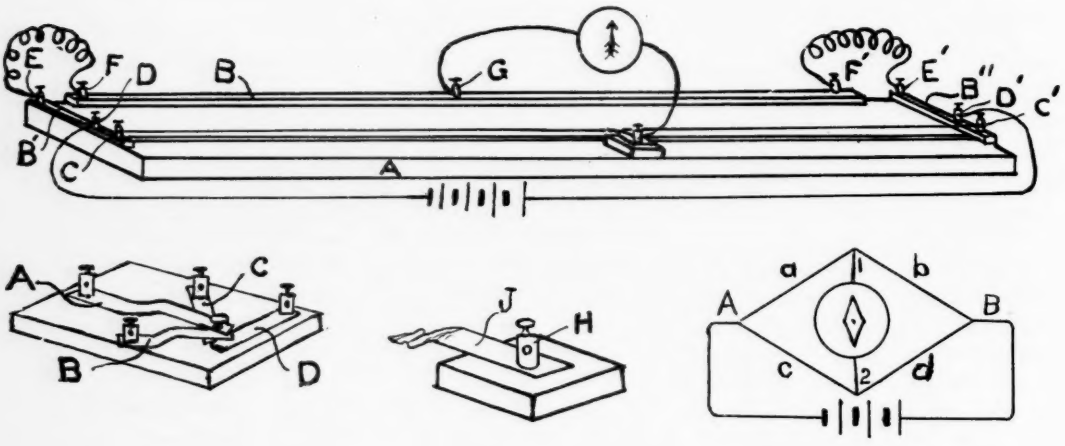
The German silver wire is strung between the binding-posts C and C′ so that it will be taut, but without tension, so the resistance of the wire will be uniform. To a small block of wood is attached a brass pointer, J, with a binding-post, H. The tip of the pointer should be slightly curved, to give a good contact with the wire, and be kept brightly polished with fine emery-cloth or a file. In moving the pointer always lift it free of the wire, so that the latter will not be scraped or bent.

Under the wire the baseboard may be marked into divisions, preferably those of the metric system. A drawing pen and india ink will be found convenient for this purpose. The ink will not "run" if the wood is sandpapered and then a little talcum powder rubbed over it before marking.

In using this instrument more satisfactory results are secured if a bridge key is used. This is made as follows: On a baseboard 7″ long, 5″ wide and ¾″ thick, four binding-posts are attached with a strip of flexible brass leading from each, so

that the free ends of each will rest over one point. These strips are bent so that they will not be in contact except when pressed by the hand. A piece of rubber or cardboard is attached to the upper side of the strip C, so that no connection can be made between the strips B and C. This allows a circuit to be made first through the pieces A–B and then with more pressure through the pieces C–D.

The Wheatstone bridge utilizes the form of a divided circuit in which the current in one branch may be adjusted to equal or "balance" the current of the other branch, and which will be more clearly understood by examining the illustration.



The current flowing through A divides, through the branches a–b and c–d. The potential at any point in the branch a–b will equal the potential at some point in the branch c–d. If these two points (1 and 2) in the branches be connected through a galvanometer, the needle will not be deflected, which would not be the case if the potentials differed.

This instrument is so arranged that in dividing the circuit, known resistances may be utilized to secure a balance with an unknown resistance, thus determining the latter. The known resistances are usually made in the form of coils of insulated wire, of such lengths and size as will make comparisons easy; such as 1, 2, 3, 5, 10, 25, 50, 100 ohms and higher when desired. A table of resistances of copper wire will give the quantity necessary to secure any resistance required. The winding is done in a peculiar manner to avoid self-induction, the wire being doubled upon itself before being wound.

The bridge key is used to send the current through the branches of the bridge before allowing it to pass through the galvanometer; the former, together with the coils, etc., becoming saturated with the current, thus creating no violent deflections in the galvanometer when brought into circuit. The posts A and B are connected to the battery circuit and the posts C and D to the galvanometer circuit. A slight pressure on the knob makes the contact between A and B, and more pressure makes that between C and D. The pointer is moved along the wire and coils are changed until a balance is obtained, the unknown resistance then being easily determined. Much interesting experimental work can be done by the amateur with this instrument in the way of testing the resistance of the wiring of toy motors and of batteries.

STUDIES IN ELECTRICITY.

IX. ELECTRIC ENERGY.

The water stored in a reservoir is conveyed by a pipe to a mill, where it may be converted into mechanical energy. The quantity of water passing depends upon the rate of flow and the time during which it flows. The gallon is a unit of liquid measurement, and the gallon-per-second could be applied to express the quantity flowing. The electrical unit of quantity is called the coulumb, and is the amount of electricity of a strength of one ampere passing through a conductor in one second. At one ampere flowing for 15 seconds, or 15 amperes for one second, the quantity of electricity delivered will be 15 coulumbs. An ampere-hour therefore equals 3,600 coulumbs. The capacity of storage batteries is frequently expressed in coulumbs.

If the water in a reservoir is delivered under sufficient pressure to turn a turbine, the energy stored in the water is converted into power depending upon the quantity of the water and the height through which it falls. Similarly, an electric current flowing through a circuit conveys electric energy from a battery or dynamo to some point in the circuit, where it is converted into work by means of a motor, battery furnace or lamp. The motor transforms it into mechanical work; a battery utilizes it for electro-plating or chemical work; the furnace and lamp produce heat and light.

Mechanical energy is expressed in foot-pounds, one foot-pound being the amount of work performed in raising a mass weighing one pound through a distance of one foot. The unit of electrical energy is the joule, which is the work done in sending one coulumb through a difference of pressure or potential of one volt, and equals .7372 foot-pounds approximately. If three coulumbs flow through a circuit at a distance of potential of one volt, the expenditure of energy would be three joules.

Power is the rate at which work is done, and the reader must carefully distinguish between the amount of work and the rate or time of doing it. When electrical work is done at the rate of one joule per second, the power exerted is called a watt, which equals .7372 foot-pounds per second, or 44.23 foot-pounds per minute, approximately. Mechanical energy being expressed in horse-power, which is equal to 33,000 foot-pounds per minute, or 550 foot-pounds per second, one watt equals $\frac{1}{746}$ of a horse-power, and 1,000 watts, or one kilowatt, equals 1.34 horse-power; or roughly, $1\frac{1}{3}$ horse-power. If the meanings of these terms are remembered, the estimating of the power of a dynamo or battery will not be difficult. To find the number of watts of power a dynamo supplies, multiply the number of amperes of current by the number of volts at which the current is driven.

Previous mention has been made of the necessity of having a complete or closed electric circuit in order to maintain a steady electric current, such circuits consisting of two essentially distinct parts. In one part, as illustrated by the electric light mains along the streets, the potential constantly decreases as the energy is converted into heat, light, or mechanical power; in the other, illustrated by the dynamo, the electricity is raised from a low to a high potential, to maintain the power available in the circuit. The electrical transmission of energy is somewhat analogous to an endless driving belt running on two pulleys. The driving pulley corresponding to the dynamo gives energy to the belt, corresponding to the wire circuit which conveys it to the driven pulley, corresponding to the electric light or motor. The backward pull of the driven pulley also illustrates the counter electromotive force (C. E. M. F.) of a running motor, the rotation of the armature generating an opposing current to that which excites it.

When by means of an electrical machine such as a dynamo, one form of energy is transformed to another form, there is always some loss. Besides the losses due to mechanical causes, such as friction, there is an electrical loss due to resistance, heat being produced even when this is not the form of electrical energy wanted. The useful

consequently less than the amount of rg y used up to produce it. The value of an electrical machine for converting one. form of energy into another depends, therefore, upon the proportion of useful energy produced to the amount used up in the process, this being known as the "efficiency."

We are all more or less familiar, at least in a general way, with those forms of electrical machines known as the dynamo and motor. The former converts mechanical energy into electrical energy, and the latter converts electrical energy into mechanical energy. Both are forms of electro-magnetic machines; that is, a magnetic field and an electric current are characteristics of both. As they exist to-day, they may be considered as especially efficient machines for the conversion of energy.

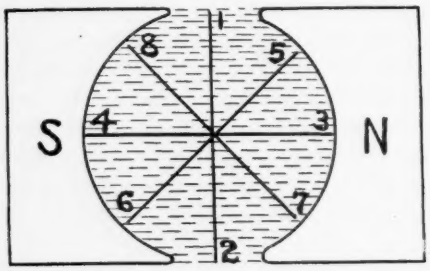


FIG. 25.

The causes which operate to produce an electric current from a dynamo will first be considered. The power of attraction and repulsion of some forms of electro-magnets has already been considered. The space surrounding such magnets in which this influence is active is known as the magnetic field, which is made up of magnetic lines of force. These lines of force emanate from the positive or north pole, towards the negative or south pole, as illustrated in Fig. 25, which shows the magnet field of a dynamo. These lines of force never cross each other, but tend to follow the shortest path from the positive to the negative pole, each line repelling every other line, and tending to get as far away as possible.

The operation of a dynamo depends upon the principle that an electric conductor, if moved in a magnetic field so that it cuts a constantly varying number of lines of force, will induce an electric current, provided there is a closed circuit through which it may flow. This current is proportional to the rate at which these lines of force are cut, which in turn depends upon the density of the magnetic field, the area of the conductor and the speed with which the conductor moves. In Fig. 25 this is illustrated in a general way. The space between the north and south poles of an electro-magnet forms the magnetic field filled with the lines of force. The armature is represented by a single coil of wire in four positions, which, as it revolves, successively cuts the lines of force, thus inducing a current. The direction and strength of the current constantly changes as the coil revolves, and this we will now consider. Assuming that the movement begins with the coil in the position 1–2, it will be seen that to reach the position 3–4 it cuts an increasing number of lines, and then a decreasing number in reaching the position 2–1. During this movement the current increases to its maximum and then decreases to nothing. Continuing the movement until the coil again reaches the position 1–2, the current increases and diminishes as before, but is in the reverse direction. To obviate this fluctuation in the strength and direction of the current the armature of a dynamo is made up of many coils of wire, the terminals of which are so arranged that a continuous current in one direction is secured. How this is done will be considered in the next chapter.

LAMPBLACK, which for hundreds and hundreds of years has been the chief ingredient in dark pigments, may perhaps be eventually displaced by acetylene-black. The chief merit of the new substance lies in its freedom from grease, and therefore in its more ready manipulation. It is said that acetylene-black is admirably adapted for the uses of the manufacture of printing inks. The high cost of acetylene-black is the only obstacle that bars its general introduction. A field is therefore opened to inventors in devising a method of producing the substance cheaply in large quantities.

A Marconi wireless telegraph station is to be established at Sagaponack, L. I., and will probably be the central station of the United States.

A FACTORY is to be started in Philadelphia for making cloth, resembling silk, from wood pulp.

AN EASILY MADE WARDROBE.

S. Vokes.

To make this piece of furniture get the following material, all whitewood:

2	boards	1′	3″	wide	7′	long and	$\frac{7}{8}$″	thick.
2	"	1′		"	8′	" "	$\frac{7}{8}$″	"
2	"	10″		"	8′	" "	$\frac{7}{8}$″	"
16	"	6″		"	7′	" "	$\frac{1}{2}$″	"

the latter being matched for sheathing the back. Also 88′ of $\frac{7}{8}$″ molding and 8′ of 3″ molding for cornice.

the remaining board (now 9″ wide), and cut two strips $2\frac{1}{2}$″ wide, leaving 4″ strips. Plane up the edges of three of the 3″ strips, the 4″ one, and two 3″ short strips 8″ long. Then fit them all in their places, which can easily be determined by referring to A, Fig. 2. The 4″ piece is fitted 1′ 2″ from the top, and forms a rail for clothes-hooks, and is continued on the sides to form ledges for shelf to rest on. The two $2\frac{1}{2}$″ pieces are used

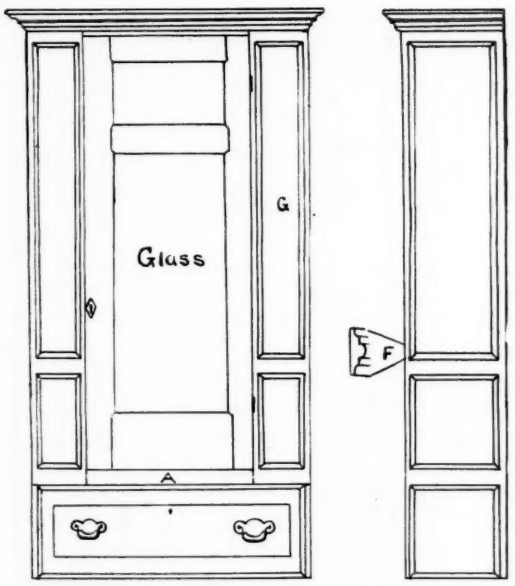


Fig. 1.

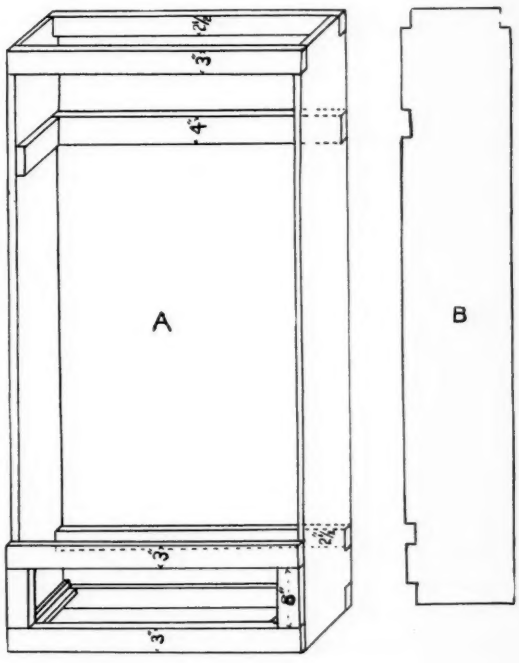


Fig. 2.

Take the boards 1′ 3″ wide and cut them as shown in B, Fig. 2. To do this and so as to get them both alike, I screwed them together with a screw at top and bottom, planed the edges, marked the places for the saw-cuts, and cut out the mortises before taking the boards apart. Then take the 12″ boards and cut strips 3″ wide the whole length. Cut these strips into lengths of 3′ 6″, making four of them. Cut 3′ 6″ off one end of

in the back. At this stage be sure to get everything square, or you will have trouble later on. Now put in ledges for the drawer to run on, and the wardrobe will look like A, Fig. 2.

You can now put in the floor, which is cut from the $\frac{1}{2}$″ match board, and should be put in so as

just to clear the top of the drawer. The shelf can then be fitted, and top and back nailed on; all of which are of the $\frac{1}{2}''$ match boards. Take the remainder of the 12″ board and cut two pieces $8\frac{1}{2}''$ wide by 5′ 10″ long, and fit them to the front to form the doorway (G, Fig. 1). The best way to do this is to cut them about $8\frac{5}{8}''$ in width and nail them in place, using small-headed wire nails for this purpose. Leave an opening for the door 2′ 1″ in width, and what projects over the sides can easily be planed off when finishing up the work, making a smooth joint.

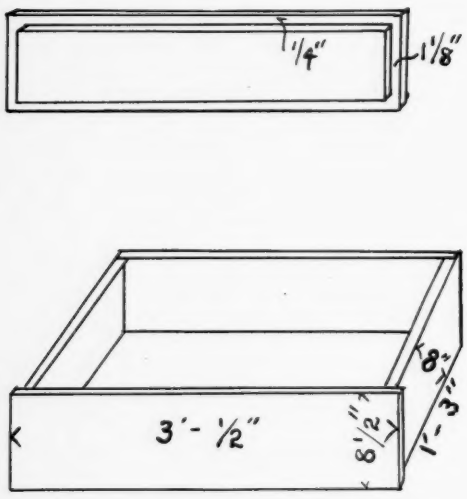


Fig. 3.

The drawer is now to be made. It is 3′ long, 1′ 3″ wide and 8″ in depth outside. For the front, take a piece 3′ $\frac{1}{2}''$ long by $8\frac{1}{2}''$ wide, which has to be rabbeted $\frac{1}{4}''$ on the top inside edge to the depth of $\frac{7}{16}''$, bottom edge $\frac{7}{8}''$, and ends $\frac{1}{8}''$, all to the same depth. (See Fig. 3.) Then take the two side pieces 1′ 3″ by 8″ and rabbet the inside bottom edges to take the bottom board, and rabbet the back ends to take the back board (Fig. 3), which like the bottom of the frame, is $\frac{1}{2}''$ match boards. The drawer should be put together temporarily, and fitted so as to slide easily before being glued up. When correctly fitted, glue and nail together.

To make the door, saw two strips 4″ wide by 6′ long, two 4″ x 2′ 2″ and one 8″ x 2′ 2″; rabbet the two long strips, one 4″ short strip and the 8″ short strip on one edge, and the other short strip on both edges, $\frac{1}{2}''$ wide and $\frac{7}{16}''$ in depth. Mark the long strips slightly longer than the length you want your door to be, and the short strips slightly longer than the width of your door, so as to allow for fitting, then mark and cut your tenons and mortises as in Fig. 4, which is drawn to scale.

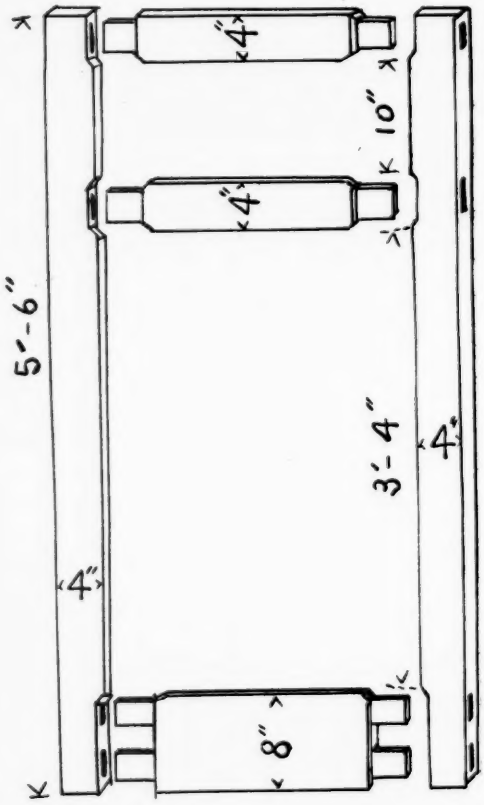


Fig. 4.

The best way to cut your mortises is to mark them and then bore them out with a brace and bit, boring half way through from each side, so as to get them quite square and true. To mark the cross-pieces, I centered them and marked 9″ each side of the center line. This gave me my inside measurement for mirror. Now glue up your door and fit and hang it. Then fit cornice and molding on front and sides, as shown in Fig. 1.

F is the pattern of a small molding which will give a very neat and finished appearance, but any similar pattern may be used. Now fit your mirror 3′ 4″ x 1′ 6″, put in wood or glass panel at top of door, fit your locks and handles, and the wardrobe is ready for staining. I stained mine walnut, for which take burnt umber—½ pound will be plenty; thin it down considerably with turps. Try it on a piece of the waste wood till you get the proper color. The stain can be put on with a brush and rubbed off again with a rag, or it can even be put on with a rag. If properly done it makes a very pretty stain, only be sure to get it thin enough. The nail-holes have now to be puttied up with putty stained with burnt umber, to the same color as the wood. Then give two coats of varnish, and the work is finished.

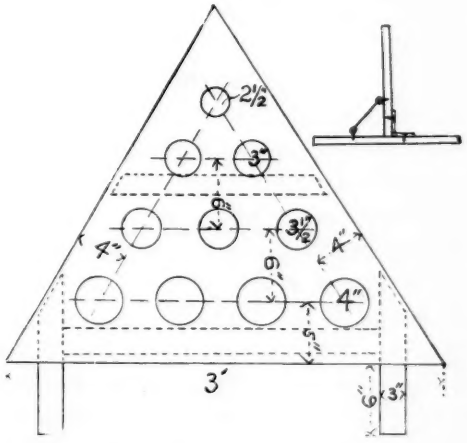
PYRAMID—A NEW GAME.

How to Make and Play It.

Frank N. Wilson.

This game is designed to afford amusement in the limited space of a dining-room, the dining-table being used as part of the equipment. The illustration will show the general design of the board. The wood used should be about ½″ thick, the sides of a shoe packing-case serving nicely for the purpose, provided the joints are even and well closed up. Spare parts of the box are used to make the necessary cleats and supports. The board is in the form of a triangle, the base being 3′ and the height 2½′. To lay out the location for the holes, lightly draw a line parallel with the base and 5″ above it, a second line being drawn 6″ above the first one and a third line 6″ above the second. On each side, 4″ from the edge, draw lines, the top hole being placed where they meet.

The lower row of holes are 4″ in diameter and the centers 7″ apart, the second row 3½″ in diameter and 7″ apart, the third row 3″ in diameter and the centers are where the side and the cross-lines meet. The top hole is 2½″ in diameter. The holes are most easily cut out with a key-hole saw, a hole being bored with a bit, from which to start sawing. Cleats are screwed to the back, under the lower and third row of holes. Upright supports 1′ long and 3″ wide are screwed to the back so that 6″ will project below the bottom. A strip of wood 1′ long and 3″ wide is attached to the bottom of each support with a hinge on the rear side, so that when not in use they may be folded, thus requiring less room for the board. A large hook is screwed into each of the supports and the eyes to the bottom piece, to hold the board upright when playing. Back of each hole may be fastened a cigar-box with the upper side removed to catch the balls entering the holes, or a single large box may be placed under the lower row and a piece of cloth tacked into a framework of wood fastened 3″ back of the board to pieces of wood nailed to the cleats. The board will have a more



attractive appearance if given a coating of stain and then shellacked.

To play the game, stand the board on the dining-table so that at least 5′ of the table will be in front of the board. The player stands 10 or 12′ away from the board, and tries to throw a ping-pong or soft rubber ball so that it will strike upon the table and rebound into one of the holes. Five or six balls are thrown by one player, and the next one then tries it. Each ball entering one of the holes in the lower row counts 5; the second row 10; the third row 15, and the top hole 20; the player with the highest total winning. This game may seem rather simple, but a trial will show that it can be made decidedly interesting for young people when they are confined to the house by inclement weather.

AMATEUR WORK

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JULY, 1902

Contents

	PAGE
WIRELESS TELEGRAPHY APPARATUS	
II. Receiving Instruments, *R. C. Browne*	203
AN ELECTRIC FLASH TORCH	206
THE WHEATSTONE BRIDGE	207
STUDIES IN ELECTRICITY	209
IX. Electric Energy	
AN EASILY MADE WARDROBE . *S. Vokes*	211
PYRAMID — A NEW GAME, *Frank N. Wilson*	213
A HOME-MADE GRAMAPHONE, *R. A. Warner*	215
HOW TO BUILD A SHOP FAN, *Chas. Herrman*	217
PHOTOGRAPHY.	
A Home-made Enlarging Apparatus . .	219
Picture Photography	220
MAKING HAMMOCKS.	
I. A Net Hammock . *E. H. Perkins*	222
A CHEST MACHINE . . *M. L. Bell*	223

THE June issue of this magazine, by an unfortunate mistake, was printed upon the wrong kind of paper. A reprint has been made upon the regular paper. Any of our readers who contemplate binding the magazine when the volume is completed, may obtain a correct copy free by mailing us the old one, with name and address written upon the cover, so as to identify the sender.

THIS magazine will have an exhibit at the forthcoming exhibition of the Massachusetts Charitable Mechanics Association, opening Sept. 22 next. To add to the interest, and show the general public what AMATEUR WORK readers are capable of doing, those interested in this magazine are invited to send for exhibition suitable objects which they have constructed, and which would be suitable for this exhibit. Before doing so, however, it will be advisable to communicate with the editor, sending particulars, and a photograph, if possible, to avoid duplication or overcrowding. Applications for space have been so general that the exhibition promises to be one of the best held for many years. All readers of this magazine who may visit it should not fail to see what AMATEUR WORK will present.

THE regular chapters on Mechanical Drawing will be omitted in this and the next number, as the subject is not one of general interest during the summer months. In the September number the first chapter of the series on Projection will be given. The chapters previously given have been of much interest to many of our readers. All those who desire to become proficient in mechanics should follow these studies as they appear, and will find themselves well repaid for so doing.

A NEW device for taking soundings will be used in determining the route of the projected Pacific cable. It consists of a large iron cylinder, topped by a cone and containing air. It is hermetically sealed, except when the cylinder is immersed. Then water flowing into the cylinder and through a tube has access to the cone containing the air. Working on the principle of hydraulics and gravitation it is possible to drop the cylinder to a reasonable depth, and the pressure is indicated on a dial attached to the cone. When the cylinder is drawn up, by taking the pressure and the depth and making the proper computations, the total depth of the sea at that point is determined.

A HOME-MADE GRAMAPHONE.

R. A. WARNER.

THE object of this article is to tell how the writer constructed, from material costing less than one dollar, a talking-machine, using the disc records, with which many a pleasant evening has been spent. It is of such simple construction that our youngest readers can build one like it. It consists principally of four parts: the motor, the sound-box, sound-box holder and regulator, each of which will be briefly but fully described.

First, make from ½″ pine a box 10″ x 12″ outside measurement and 3″ deep. This is to be fastened to a base having a molded edge, by screws driven from the under side and countersunk. (See A, Fig. 1.) Cut a notch 3″ from corner 2, Fig. 2, 1″ wide, ¾″ deep. A cover is now to be made that fits inside the box and rests on four posts 2½″ long and ¼″ square, glued in each corner. (See A, Fig. 1.)

With cover in place, but not fastened, lay out a center line, and also 5″ from corners 2 and 4, the line bisecting it. At the intersections of these lines (B, Fig. 2,) bore a hole in which a smooth, straight lead pencil will turn easily. Lay off a diagonal from 1 to 4, and 1″ from corner 1 make a similar hole.

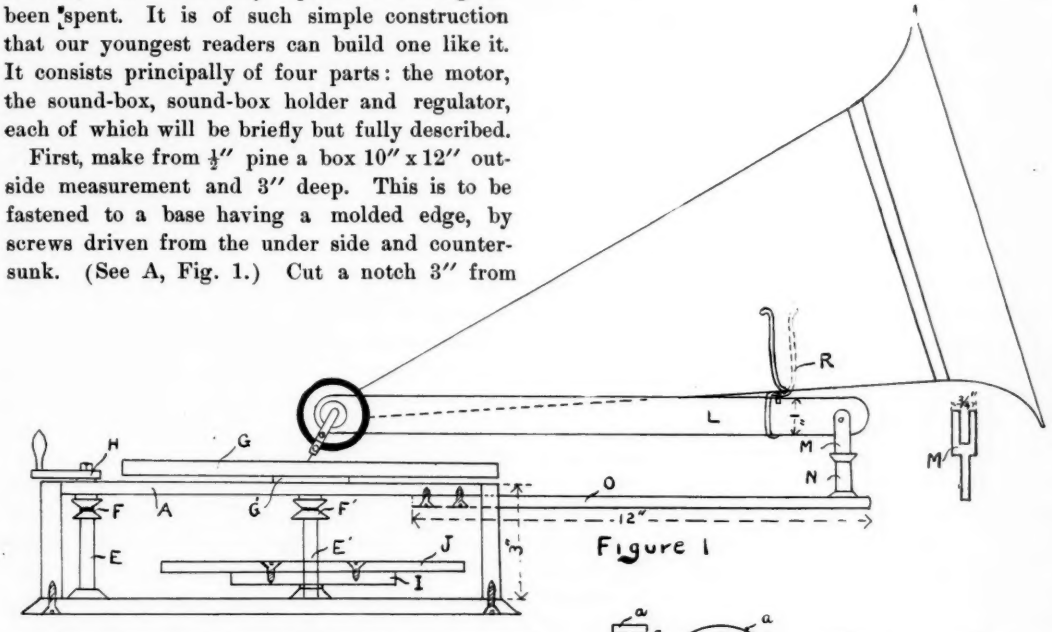


Figure 1

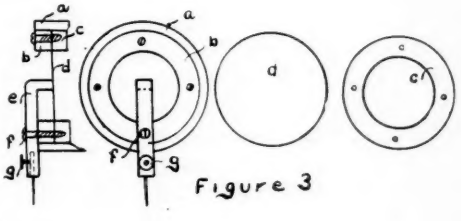


Figure 3

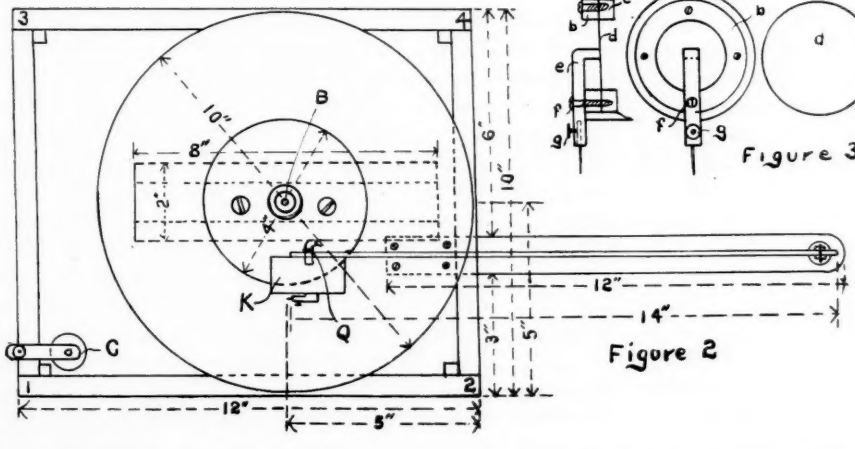


Figure 2

Directly under these holes on the bottom of the box fasten the flaring ends cut from a spool (D, D′, Fig. 1). These must be reamed out with a round file, so the lead pencil will turn without binding. Cut two pieces of a very hard round lead pencil (E and E′, Fig. 2,) 4″ and 4½″ long, respectively; the lower ends should be bluntly pointed, to reduce the friction, and one end of the 4″ length being squared to receive the crank (H, Fig. 1).

Procure two large spools such as linen thread is wound on, or a large spool of any kind, the size being immaterial, the holes in the spools being a tight fit for the lead-pencil shafts; fasten them so the tops will be ⅛″ below the cover, as shown at F, F′, Fig. 1. Loose wooden washers made from sections of a spool should be put between the spools and cover, to prevent the shaft from jumping out of the bearings in the bottom of the box. Cut grooves with a round file on the spools for the belt to run in. Take a thoroughly seasoned piece of hardwood ½″ thick and cut a disc 10″ in diameter (G, Fig. 1,) and a smaller disc of ¼″ wood 4″ in diameter; fasten the latter to under side of G, and carefully bore a hole through both pieces to tightly fit shaft E′, so the disc G will turn as true as possible. A cardboard washer may be put under this to reduce friction. Cover the top of disc with felt or baize, to provide a friction hold for the record disc. Make a small wooden crank (H, Fig. 1,) which will clear the disc G, and fasten to the squared end of shaft E. The regulator, I–J, consists of a wooden disc (I, Fig. 1,) ⅜″ thick, 4″ in diameter, to which should be fastened, with two screws, a strip of iron (J, Fig. 1,) ¼″ thick, 2″ wide, 8″ long, a hole being bored in the center for the shaft. Fasten as shown at E′, Fig. 1, with a washer under the disc. Connect the spools with a belt,—a leather shoestring makes an excellent one,—and the motor is complete.

Now comes the sound-box (Fig. 1), on the construction of which will depend the clearness and volume of the tones produced. It must be remembered that to secure the best results all parts must be constructed so as not to jar or rattle, and this applies particularly to the sound-box. Fig. 3 shows detail of parts. Procure from a druggist a round wooden pill-box 2″ in diameter and 1″ or more deep. (See a, Fig. 3.) b and c are two wooden rings ⅜″ thick, made to fit the inside of the box a; these may be cut out with a knife or fret-saw. d is an isinglass diaphragm, the same size as the rings. This should be placed between the rings and all fastened with three fine screws (the fourth screw also holds the needle-holder in place). The thickness of the isinglass is best ascertained by experimenting until the best results are obtained. The diaphragm should now be glued securely in the box a, with the outside ring flush with the edge of the box. e is a piece of steel bent or filed to shape as shown, and should have a hole bored at f for a long, slender screw, that binds both rings together. A $\frac{1}{16}$″ hole should be bored in the end ⅜″ deep; a small thumbscrew at g holds the needle in place. This part of the apparatus can be made up by a jeweller at small cost, if the reader has not the necessary equipment for making it. The end that rests against the diaphragm should be smooth and rest flat, being kept in contact by melting a little sealing-wax and pouring around it. Get two short gas-pipe nipples and a ¼″ elbow, and fasten by screwing into the bottom of box a, in hole previously made. (See O, Fig. 2.) This completes the sound-box.

Take a piece of hard wood (L, Fig. 1,) 1″ wide, ¼″ thick and 14″ long, and bore a hole in one end, fastening to the sound-box by screwing nipple through it to sound-box. (See L, Fig. 1.) Make another piece ¼″ thick, 1″ wide and 12″ long (see O, Fig. 1), on one end of which fasten another spool, N, by nailing up through strip into spool Make a fork, M, as shown in Fig 1. This should be connected to arm L, and should turn easily in spool N. The height of the spool and fork should be such as to cause the arm L to rest parallel with disc G. This completes the machine; but before fastening, it should be adjusted. Turn the sound-box so the needle slants about the angle shown in Fig. 1. The arm O should now be pushed forward or backward in notch until the needle-point rests on a line with B on disc G, and the two arms L and O are in line with each other. (See Fig. 2.) The arm O may now be screwed to under side of cover. The records come in two sizes: 7″ at 50 cents each, 10″ at $1.00; the 10″ record producing much the louder tones and longer pieces. Also get a package of needle-points: 100 for 10 cents. A horn may be made of heavy paper, or a metal one can be bought for 50 cents

to $1.00. It should be fastened securely to the nipple and be supported by wire, R, attached to the arm L, resting under the horn. To operate, place a record on disc G, swing the sound-box by the arm L, so the needle-point rests on the outside edge of the record; then turn the crank, and if you have followed these directions you will be well repaid for the time and trouble you have used.

The description of this machine has intentionally been as simple as a cheaply made machine will allow, and outside of the cost of the records should be built for less than one dollar for materials. After the success of the machine has been assured another may be constructed as elaborately as the builder may wish. Made with hardwood and metal parts, it will compare favorably with a machine of many times its cost. If several are made in one neighborhood, records may be exchanged, thus getting a variety of pieces at little cost.

HOW TO BUILD A SHOP FAN.

CHARLES HERRMAN.

WHEREVER there is shafting running, thus supplying a source of power, and the summer heat is felt, thus calling for an artificial breeze, there is room for the ingenuity of the amateur worker in the making and the driving of a fan. The one here described can easily be made, costs very little, and once properly assembled and put up, will last for years, with only an occasional oiling. One of the foremost machine shops in the world has over one hundred of them, and considers them unbeatable for their cost.

The fan completely assembled is shown in Fig. 1, partly in cross-section, to simplify explanation. A is a piece of 1″ shafting of the proper length; B is a piece of 1″ pipe of suitable length (it must be remembered that piping is measured by the internal diameter). C is a split wooden pulley (preferably flanged, though this is not absolutely necessary), which when drawn tightly together takes firm hold of pipe B. D is a wrought or cast iron collar, held securely at the bottom of pipe B by means of a set screw, and has two ⅝″ holes tapped through it (diametrically opposite) for the wings or fan blades to screw into. E E are two ⅝″ rods or shafts, threaded for 1½″ of their length at one end, so as to enable their being screwed into collar D, the rest of the length being flattened (either filed, shaped, or, best of all, blacksmith-hammered), to allow of a flat contact with sheet iron blades F, to which they are joined by rivets or screws through three holes drilled in E. The two lock nuts G G are carried on the rods E E, which, though allowing of any angular adjustment of the blades when firmly jammed against the collar D, lock the wings securely in place and keep them from working loose. H is a 1″ wrought or cast iron collar, held by a set screw at the bottom of shaft A, which serves to keep the whole fan arrangement — which revolves around the shaft A and upon itself — from falling down.

The bottom of the fan should be at least 7′ from the floor, so as to allow of the safe passage of a tall person. With the blades as set and the shaft turning as shown in Fig. 2, a downward current is had. If the shaft motion be reversed, be sure to reverse the angle of your fan blades, or you will only be fanning the ceiling. When erecting the fan the shaft A must go up first. Be sure to have it plumb *both* ways, or the belt will run poorly or not at all.

Figs. 3, 4 and 5 show three ways of fastening to the ceiling. In Fig. 3 it is fastened to one of the ceiling-supporting rafters by two lag screws or bolts running through the timber. The shaft need not be flattened where it comes in contact with the rafter or where the bolt-head touches it. It will hold the more firmly if not weakened by filing. Fig. 4 is self-explanatory, lag screws being used to hold the shaft to the timber.

In Fig. 5 the shaft is threaded sufficiently to allow two 1″ nuts (with washers if a wooden plate, or without them if an iron plate is used) to be placed one above and one below the plate, to lock the shaft into position. To bring the shaft plumb

both ways in this case the plate must be shimmed level both ways.

Assuming that we have got our fan up and plumbed (we have, of course, placed it in such relation to the driving shaft as will give us a clear space on the driving shaft for the driving pulley), it is now necessary to drive it at between 200 and 250 revolutions per minute (R. P. M.). Our main shaft runs, we will say, 125 R. P. M. Pulley C of the fan is 4″ diameter; then our main shaft pulley must be an 8″ diameter to give the necessary speed to the fan. This pulley should be a split wooden, and preferably flanged, though it may be iron and unflanged; if the latter, it must be crowned.

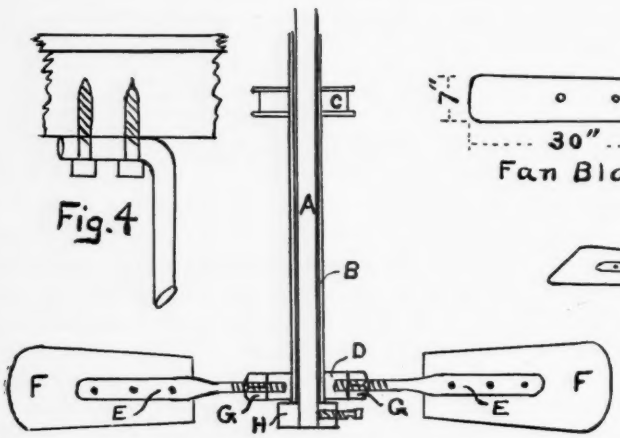
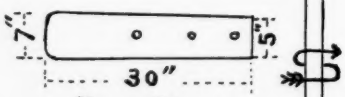


Fig. 1

Fig. 4



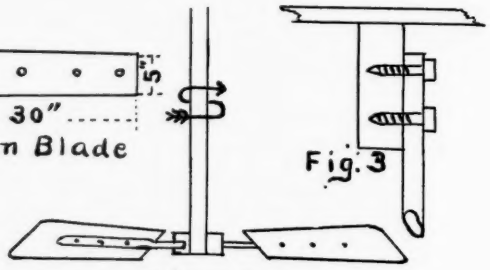


Fig. 2

Fig. 3

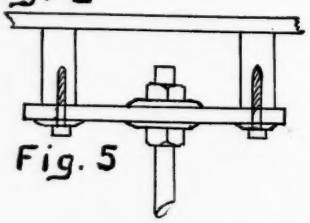


Fig. 5

A WEALTHY Russian died not long ago and his heirs could find no will. One day a young man seeing a graphophone in the library, put into it what he supposed to be the record of a song. The words which came forth were those of the missing will in the dead man's voice. The will thus curiously recorded has been submitted to the courts.

GENERAL FUNSTON says that there is no war in the Philippines; it is true that murders are of frequent occurrence; that assassins lurk in ambush and shoot down their victims passing by; but there is no war, no more than there is war in Kentucky.

WANTED.— Something besides spruce and white pine wood pulp from which cheap paper can be manufactured. These sources of supply are so rapidly becoming exhausted as to threaten the existence of the one-cent daily newspaper and other large consumers.

At present, as one manufacturer said, "paper is made from nearly every old thing." Linen and cotton rags and waste flax make the best. Old grass ropes, coffee sacks, banana peels, waste wheat and oat straw, hemp fiber, and in fact nearly everything that is thrown away, are used in its manufacture, but still the source is not equal to the demand. Experiments are now being made with all kinds of grasses, bamboo fiber, banana stalks, dis grass from the north coast of Africa, leaves of the dwarf palm, sugar-cane bagasse, hop plant, ramie, agave, nettles, sea grass, etc., and some promise well of success.

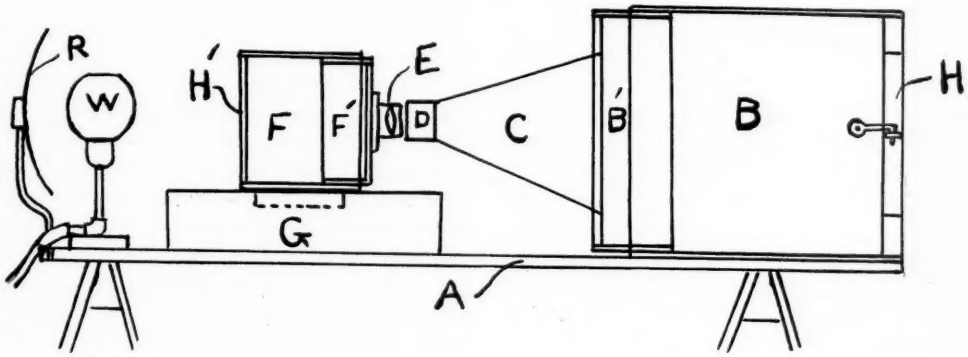
Says the *Southern Industrial Review:* "A material which nature may renew yearly must be discovered and adapted to the trade, and the most natural sources must be sought in the field of agriculture or among the fibers and grasses which have annual growth."

SIXTY new storm-warning towers, equipped with the latest improved lanterns, have been installed at the Great Lakes by the U. S. Weather Bureau.

PHOTOGRAPHY.

A Home-made Enlarging Apparatus.

The amateur photographer, with a 4 x 3 camera, who has reached the ability to make good negatives, usually has a growing desire to make enlargements. The cost of an enlarging apparatus is often more than many care to expend on what to them is but a pastime. Those who are in this predicament may find this description of an enlarging apparatus a solution to their difficulties. It is easily made by anyone possessing a little skill, and possesses about all the desirable features of an expensive outfit. Various sizes of enlargements can be made, as the focus can be easily adjusted. The sizes here given can be modified to suit the necessities of any size of plate or enlargement.



A well-seasoned baseboard, A, 5′ long and 12 to 15″ wide is the first requirement. Two wooden horses similar to those used by draughtsmen are very handy, but a table may be used for the work if it is not convenient to have the horses. Procure from your grocer two packing-cases in good condition, made of thin planed wood. Those used for shipping cereals are just the thing. Make a square box, B, without ends, 18″ square inside and the same in length. Reinforce the ends by cleats 1″ wide around it, nailing with short brads from the inside. Make another box, B′, which will snugly fit the inside of the first one, but only 6″ long, with a front made of wood ½″ thick. Before fastening in the front, cut with a fret or key-hole saw a circle large enough to receive the large end of a cheap pasteboard megaphone, C, which forms a cone-shaped connection with the lens. This can easily be made of pasteboard if desired, by gluing several layers of flexible pasteboard together, and finishing with a coating of leatherette or paper, to be obtained of any bookbinder. The cone should be well fastened to the wooden front of the box B′ with upholstering tacks, and should be lined and all cracks covered with dull black paper.

The interior of each of the boxes should also be covered with black paper to prevent the reflection of light, which would injure the quality of the enlargements.

The front end of the cone may be fitted with a tin tube made from a spice-box of suitable size to fit the lens, E. This can be omitted and a thick pasteboard end with a hole in it for the lens, used, if no great amount of work is to be done.

If the camera has not a removable back, two additional boxes, F and F′, are required. These are made in exactly the same way as were the boxes B and B′. The box F should be 9″ square inside and 8″ long, the box F′, which is 3″ long, fitting it snugly. One end of the box F′ is made of wood ¼″ thick with a hole in the center for the lens. The lens, when used for enlarging, is removed from the camera and attached directly over this hole. A camera with remov-

able back, and a bellows, may be used in place of these boxes. Two boards, G, 20″ long, ¾″ thick and of the necessary height to bring the box F to the position so the lens will exactly meet the mouth of the cone, are nailed to a bottom board 6″ wide. If the boxes are made on the under side of the box F, nail from the inside two ½″ square strips of wood, so that they will be parallel with the pieces G, and keep the box F centered and in position when focusing.

For the outside end of the box B make a shallow box, H, like a single plate-holder, or a large plate-holder may be purchased and the dividing partition removed, in one side placing a ground glass, for focusing, and when ready to make the enlargement, placing the paper in the other. If a holder is made the ground glass should be separately mounted in a wooden frame, both holder and ground glass being kept in position by brass hooks on the sides and top of the box B and eyes in the holder and frame. For holding the negative a plate-holder with the partition taken out will serve nicely, having the advantage of allowing the light to be shut off at any time with the slide. It is fastened to the box F with hooks and eyes.

If enlarging is to be done at night and gas is available, a Welsbach burner, W, with thin ground-glass globe, apple shape, is excellent, but must be moved carefully to avoid breaking the mantle. If a low wall-bracket is to be had, the apparatus can be placed at a suitable height for using it. If not, have a gasfitter connect two short lengths of ½″ pipe to an ell, one end connecting with a hose supply pipe and the other having a nipple, on which is placed the burner. The center of the burner should be exactly in the center of the negative and about 10″ away from it. A 10″ or 12″ glass reflector, R, is mounted on an iron rod, the lower end being bent so as to fit a hole bored in the end of the baseboard A. If enlarging is by daylight, fit a small mirror in place of the lamp, so that it may be adjusted to reflect the light squarely on to the negative. The position has to be changed at intervals as the sun moves towards the west.

In operating, place the negative and ground glass in position, adjust the position of the boxes until a clear image of the required size is shown on the ground glass. Remove the ground glass, and place in position the holder containing the print paper, the holder being filled in the dark-room. Give the necessary exposure, previously determined by exposing small strips of paper until the right interval has been ascertained. A little practice will soon enable one to produce very satisfactory enlargements.

PICTURE PHOTOGRAPHY.

To many beginners in photography there eventually comes a time when a sufficient number of negatives of friends, the interior and exterior of the home, the cat, dog and other household pets, etc., have been accumulated, and the mind craves for work in a field which has less of the personal and more of the artistic character. This impulse is often quickened by some print in a window, or reproduction of a beautiful landscape, or shore scene in a photographic or other magazine, and fills one with a desire to produce similar work. This is not so much due to a wish to be an expert in photography as it is a craving for the artistically perfect, the presentation in the finished print of a view with character and sentiment possessing an intrinsic charm over which we delight to linger and return to with pleasure.

Before we can attain this degree of skill, however, we must learn enough of the processes by which these results are accomplished, to intelligently plan our work, and then be able to follow the plans so that guesswork and chance are eliminated as far as possible.

A proper equipment is the first essential. This does not necessarily mean that it shall be very expensive, but does rule out the so-called fixed-focus cameras, many of which are made mostly for selling purposes. A well-made camera, capable of taking at least a 5 x 7 plate (6½ x 8½ is better), equipped with a good rapid rectilinear lens, reversible swing back, adjustable front, rack and pinion-focusing movement, and a well-made leather extension bellows, are all necessary features. A strong, rigid tripod, ray screen and extra plate-holders should also be included, together with various other devices required for special occasions.

Assuming that practice has made familiar the uses of all these fixtures of the camera, and that the holders contain the plates best adapted to the

work in hand, we start afield. It should not be an aimless trip, with the expectation that the right view will be found about the time the load becomes so heavy that a rest seems desirable. Quite the contrary. Not only should the objective point of our excursion be previously determined, but the kind of day and the time be carefully considered, so that all the conditions of light and shade will be appropriate to the scene. A well-known artist photographer, whose prints enjoy a world-wide reputation, told once in an interview of a trip during which he waited over two weeks for just the right conjunction of the elements, that he might secure the effect he desired. How many of us have developed the patience and discernment this implies; and yet the results are well worth it. This example also illustrates the necessity of making a careful study of the "make-up" of the scene, usually expressed as the "composition" when applied to pictures. This can perhaps be better understood if we assume that instead of taking a photograph, a water-color or crayon was to be made. Before commencing work careful study would be made of the scene from several viewpoints; the direction of the light, the location of trees, shrubbery, rocks or water would all be carefully noted. The slope of the land, the line of a fence or wall, the angles of a building, and the position of a road or path are all to be selected so that the grouping will be harmonious and well balanced.

The subject of "composition" has been repeatedly written up, and in the minds of some writers is subject to many rules and more exceptions. To the amateur who pursues photography as a pleasure, the reading of a treatise on this subject would be likely to leave only a confused jumble of ideas, far from helpful. After some experience and a study of results, such works can be taken up with profit. One of the best methods for the beginner is the making of three or four negatives of some attractive scene, from as many different positions, and then making a comparative study, that the strong and weak points may be clearly discerned and utilized for future guidance. Also to study the grouping, both as a whole and in part, of photographs by artists of note, which seem attractive. Many a photograph is improved by a judicious trimming of a part. A very common fault with beginners is their desire to include too much in a view. More strength and character is to be found in a picture in which the motif is a single feature, and all the rest a suitable setting or support for it. To summarize: study your own work, and as much as possible the work of those artists which most nearly appeals to your own tastes.

Do not try to find pleasure in work which to you seems unnatural or contrary to your own temperament. We all have our individual peculiarities, and should try to develop them along correct lines. Any attempt to work counter to our natural disposition will but delay, and perhaps destroy, a full development of the artistic side of our nature. Let our work be true, and represent as nearly as possible our best ideals; only in this way will we achieve results that will accord with our highest capability.

Directions for making luminous photographs, published originally in a German paper, are thus translated in *Popular Science News:* "It is done by means of calcium sulphide, otherwise luminous paint. A sheet of transparent celluloid is coated with an emulsion of nine parts of gelatin, one of potassium bichromate, five of calcium sulphide, and one hundred of water. The gelatin is soaked in the water and melted in a water-bath, the other ingredients being added afterward. When the coated film is thoroughly dry it may be printed upon from a positive through the celluloid film. This precaution is necessary to prevent the image washing off during development, which is done by hot water, as in the case of a carbon positive. Backed up by black velvet or paper the print will appear as an ordinary black-and-white positive by daylight, to which it should be freely exposed, and will be self-luminous in the dark."

An electric railway was built on the ice across the river Neva at St. Petersburg, Russia, last winter, and cars crossed in safety for several months. There are few bridges at this point, says the *Tramway World* of London, and the ice railway did a big business. The river is nearly a mile wide at this point. The trolley poles were set by chopping holes 18 inches deep in the thick ice, and pouring in water around the frames. When the water froze the poles were as firm as if set in the earth.

MAKING HAMMOCKS.

E. H. Perkins.

I. A NET HAMMOCK.

In making a hammock, a little practice in tying the knots is advisable as the first step. The peculiar yank which brings it to the desired position, and also pulls it taut, is soon gained by a little practice. It is best, therefore, to make trial meshes until they can be made evenly and the knot properly tied on the top of the mesh-stick. Make the knot slowly at first, until both speed and exactness are possible.

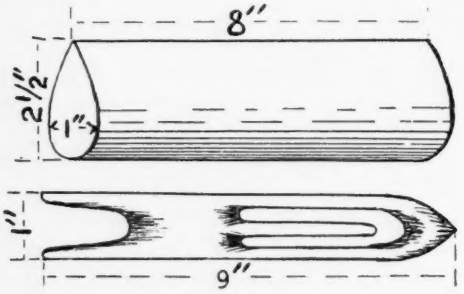


Fig. 1.

The materials required for a hammock the bed of which is 8′ long, will be two balls of No. 16 soft finished cotton cord, two iron rings 3″ in diameter, a hardwood mesh-stick and a netting needle. The mesh-stick is preferably of the shape shown in the illustration, but may be round or flat, and should be 8″ long and 2½″ wide to make an average-sized mesh. It must be held under the palm of the left hand in such a way that the thumb and forefinger are free to guide the knot.

The needle is 9″ long, 1″ wide and ⅛″ thick. After cutting it out with a fret-saw or knife, it must be smoothed with sandpaper, that it may work easily. To wind the needle, pass the twine alternately through the fork and around the tongue and over the shank on either side of the needle, so that the turns of the twine are kept on by the tongue and fork. Fill the needle as full as possible, to prevent too frequent joinings. Hold the needle flat in the palm of the hand, using the forefinger to guide it.

To make the knot shown in Fig. 2 pass the twine from the last formed knot over the front of the mesh-stick and through the mesh above, holding the twine about the mesh-stick firmly with left thumb. Throw a loop of the twine over the stick and left wrist, as shown in Fig. 2, and push needle between 1 and 2, and pull knot tight, as shown. But little study and practice will be necessary in order to get the knot firm and in position on top of the mesh-stick.

To begin the hammock place one ring on a stout hook or anything strong enough to stand the strain of continued pulling, and set up about thirty leaders. Ten more will make a large hammock. In making these leaders, a thin board 3′ long and 5″ wide is held close to the bottom of the ring, and

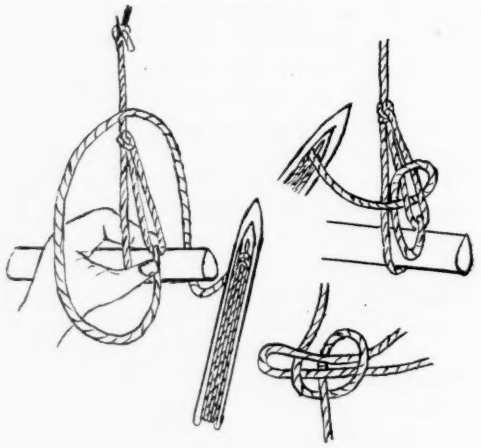


Fig. 2.

presses against the body at the other end. Make the first knot on the ring, then passing the twine around the board make a second knot in the ring, and continue until the forty leaders are made.

To make the body of the hammock, turn the ring over so that the last leader made will be at the left, and with the small mesh-stick in position, pass the cord in front, then back through the first

long mesh or leader, making the knot as previously directed. Make as many knots in the corresponding leaders as the mesh-stick will hold; then pull off all but three or four, and go on across the row. In beginning a new row place the top of the mesh-stick at the bottom of the last row, winding the cord from the last loop around the mesh-stick and up into the loop above for the first knot. Make as many rows as desired, and finish the hammock by using the long mesh-board, as in the beginning, to make the leaders of the other end, tying the knots in the second ring.

When the hammock becomes too heavy to handle easily, run a cord through a row of meshes about five rows back and tie to form a loop, hanging it upon the hook. This may be done to advantage several times in making the hammock.

When joining becomes necessary, the weaver's knot is the most desirable to use; but care must be taken to leave ends long enough, that the weight of the body will not pull them out. To still further strengthen these joined places the ends may be wound about the meshes with twine.

A CHEST MACHINE.

M. L. Bell.

The chest machine which I have described may easily be made by any one at a very slight expense. The wooden parts of this machine were made from pine and then varnished; but if preferred, some hard wood might be used, and would make a much nicer looking apparatus.

For the headboard, select a piece of lumber 20″ x 4½″ x ¾″. As a support for the upper ends of the guide rods, take a block 5″ x 1¾″ x 1¾″, and in the middle of one side bore two ¼″ holes 3″ apart. Midway between these holes put an ordinary screw pulley, such as may be bought at any hardware store for about five cents. The diameter of the wheel should not be over 1½″. Secure this block, pulley downward, to the center of the head, and the headpiece is complete. (Fig. 1.)

The support for the lower ends of the rods is made from a block 8″ x 4″ x 1″, in which two ¼″ holes 3″ apart and 1¾″ from the back edge are bored. The rods which guide the weight are made of ¼″ brass curtain rods, and should be long enough to reach from your shoulders to the floor.

Next comes the weight-carrier (Fig. 2). It is made from two boards 5¼″ x 3″ x ½″, in each end of which is cut a socket 1″ x ½″. Two ⅜″ holes, 3″ apart, are put through the centers of both boards, as when finished they are to run up and down on the rods.

In one board, midway between the two holes, is fastened a pulley. These boards are now fastened together by two pieces of hard wood 7″ x 1″ x ½″, these sticks fitting into the sockets in the ends of the boards.

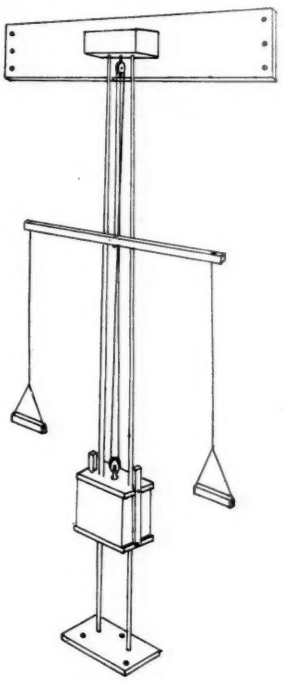


Fig. 1.

As a mold for the weights, I made a box, the inside dimensions of which were 3″ x 5″ and deep enough to hold several pounds of melted lead. At one side of the box I nailed at angles to the side, two pieces of ½″ board so that they extended a little beyond the center of the box. To the middle of the ends I also nailed a strip of wood 1″ x ½″. Both the boards and the strips extended from the top to the bottom of the box. Hot lead was poured into this mold, making a casting as in Fig. 3. If at any time it is desired to add more weight, it can easily be done by simply unfastening

the upper board of the carrier and slipping on additional weights. The side pieces of the carrier are to fit into the notches in the ends of the weights and thus prevent their sliding on each other, while the deep notches in the sides allow the weights to be taken off or put on the rods without removing them from the machine.

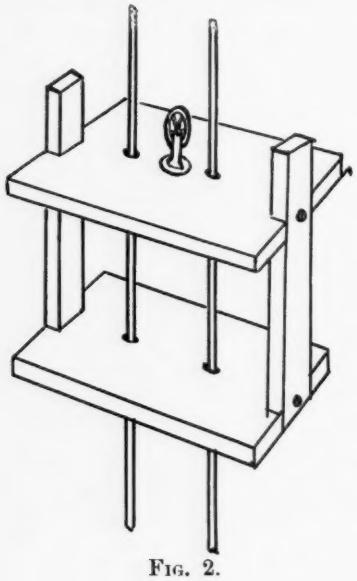


FIG. 2.

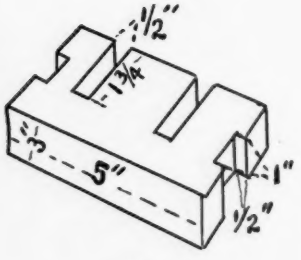


FIG. 3.

The parts are now put together as in Fig. 1. The headboard should be pushed on far enough to prevent the rods working loose, and then both head and foot boards securely fastened to the wall and floor, respectively.

For the rope, take small-sized window-cord, and having fastened one end to the headboard by a screw-eye, pass the other, from the back, through the lower pulley, and in the same direction, through the upper one. Cut off the rope, leaving an end about 8″ long and fasten the end to a wooden bar 17″ x 1″ x 1″ by passing it through a hole in the middle. From Fig. 1 it will be seen that the handles are attached to each end of this bar by ropes about 30″ long. The machine will be found excellent for those who need exercise.

CALCIUM CARBIDE AS AN INSECTICIDE.

FOR several years past the vineyards in the important wine-growing district of Beaujolais have suffered greatly from the attacks of numerous flying insects, the most important of which is known as the pyralid. Last year a series of experiments was carried out in one of the large vineyards, to see if the insects could be caught by bright lights burning at night. An apparatus was constructed, consisting of an acetylene generator holding about six ounces of calcium carbide. Over this was a circular metal dish about twenty inches in diameter, and over this at a height of about eight inches a single acetylene jet giving a small, bright light at about ten candle-power. This light the carbide was sufficient to keep burning for six or eight hours. In a basin a layer of water was placed, and on top of this a layer of kerosene or some other cheap oil, of which about two fluid ounces were required. These machines were set up about 550 yards apart, and were set in action at dusk, preferably on dark nights. On the first night one lamp caught 4,600 pyralids and 218 moths of other kinds. During July the lamps averaged 3,200 insects per lamp per night. The expense of the lamps is reported to have been two cents per night each, or about two and one-half cents per night per acre. It is said that this method of catching noxious insects is more efficacious than any method which has been tried before.— *Electrical Review.*

INFORMATION comes from Cairo, Egypt, of interesting scientific discoveries in the Fayum made by the Egyptian geological expedition. Remains of large vertebrate animals of the lower miocene were found, which indicate the early forms of rhinoceros and elephants. A representative of the geological department of the British Museum has gone to examine the remains.

NEW THEORY OF WIRELESS TELEGRAPHY.

THAT wireless telegraphy depends on disturbances of potential in the earth, regarded as an electrically charged sphere, rather than on Hertzian waves, as is usually supposed, is maintained by Rankin Kennedy. This physicist, says a writer in *The Electrical Review* (May 31), "has been unable to swallow or digest the usual statement that the workings of wireless telegraphy depend upon Hertzian waves, since he has been unable to see why such waves should be able to bend around the curved surface of the earth through many degrees of arc. . . . In effect his suggestion is very plain. The earth may be regarded to all intents and purposes as an electrically charged sphere whose charge is at zero potential. If a disturbance is set up in this charge — which we are led to believe resides upon the surface of the earth — through the connection of an insulated capacity and a spark-gap with the earth, surges of current are caused to flow; then, inevitably, ripples of electrostatic disturbance will radiate out from the disturbing point, and these may be detected at great distances by means of appropriate apparatus sensitive to electric waves. It makes no manner of difference whether the sending and receiving circuits are parallel. A somewhat curious corollary of this hypothesis is that at the antipodal point from the sending-apparatus there ought to be a maximum of effect. If the earth were a smooth sphere having a uniformly disturbed charge, the ripples radiating away from the disturbing influence in widening concentric circles would come together again at the other end of the diameter of the sphere, where their mutual interference and addition would create a point of maximum effect. It would not be extremely difficult to test this assumption. If it is found true, the explanation of wireless telegraphy is evidently at hand. It may be remarked here that the antipodal point to Mr. Marconi's powerful sending-station in Cornwall is to be found in longitude 175 degrees east, and latitude 50 degrees 30 minutes south. This point is in the South Pacific Ocean, very near Auckland Island, which lies immediately to the south of New Zealand. There the British Government maintains an admiralty supply depot. It would be very interesting to know if messages which have faded out and become no longer sensible to the receiving instruments at 23 degrees away from the sending-station would not be again easily received 180 degrees away at the antipodes. All that would be needed to try the experiment would be to send a ship provided with a receiving apparatus to the point indicated, and wait for results."

ENSIGN NELSON, expert in charge of the torpedo station at Fort Royal, has given remarkable testimony before the House Committee on Naval Affairs relative to the merits of submarine torpedo boats, which many have condemned because of the great danger of explosion. He declared that a submarine boat of the Holland type could drive an entire hostile fleet out of a harbor, because the enemy, if wise, would put out to sea to avoid attack which could not be prevented, because it would be delivered entirely out of sight. A fleet dare not approach the harbor near enough to cover the landing of troops or to make effective use of small calibered guns against shore defenses. The moral effect of a submarine boat, he declared, was even greater than its destructive ability. He predicts that the submarine boat is destined to produce as vast a change in naval architecture as that which followed the success of Ericsson's "Monitor," and urges that the United States at once develop a fleet of submarine boats of the latest and best types.

A SALT lake, the water containing 25 to 30 per cent salt, is described by the English Consul at Buenos Ayres. This lake lies in the southern portion of the Province of Buenos Ayres, Argentina, near San Blas. The rock-salt deposit underlying the lake is pierced by several springs; a syndicate is now working the deposit by running the water from these springs into banks, allowing it to settle, and then forcing it through iron pipes to the coast, 26 miles off. At the coast the water runs into evaporating pans. The syndicate is now turning out 25,000 tons of salt per annum, but the output could be increased to 100,000 tons. The Bay of San Blas is 800 miles south of Buenos Ayres; it has a deep channel and sheltered anchorage, and the syndicate is building a pier to facilitate loading.

An Inquest on a Mummy.—"Our British friends can sometimes do the unconsciously humorous thing to perfection," says the Philadelphia *Medical Journal*. "They have lately been holding an inquest on a Peruvian mummy. But this 'crowner's quest' was no more funny than the gravity with which the *British Medical Journal* assures its readers that the coroner did right. The British public have finally awakened to the fact that the coroner should be laughed at, and the mummy has been pronounced dead, because the coroner 'sat on it.' The innocent cause of all the trouble was a Peruvian mummy which some one was sending by express to a museum in Belgium. The unfortunate relic was discovered in a box in a railroad station in Liverpool. It was undoubtedly dead, but the coroner was sent for to certify to the fact. . . . He succeeded in spoiling the mummy; and a lawsuit followed, with big damages."

"While it may sound strange, it is nevertheless true, that inquiries for automobiles are being made in Syria," says *Cassier's Magazine*. "Only one specimen, an inferior second-hand French machine, so says United States Consul G. Bie Ravndal, at Baireut, has been seen there; but it is thought that in Syria and Palestine, with their lack of railways and street-cars, and with their rapidly developing carriage-road systems, automobiles would do well. A new road is now being built between Sidon and Baireut, and will soon replace the ancient bridle-path. While this road will be level, others throughout the region are steep, and make numerous sharp turns. Vehicles in use, therefore, must be strong and durable. The tourist traffic has more than doubled in Syria during the last ten years."

Searchlights are to play a conspicuous part in American coast defenses. Extensive experiments with the lights are soon to be made by General Gillespie, chief engineer of the army. The Fortifications Act of last year appropriated $150,000 for the installation of the lights in New York harbor. It is now proposed to install the same system at Portland, Me., Boston, the eastern entrance of New York, and Puget Sound. It is planned to use the target and most effective searchlights, those having a range of 2,500 yards. It is proposed this year in the manœuvers at Narragansett Bay to multiply the searchlights in such way as to determine definitely whether the main channels in the four harbors named can be lighted up.

A heavy rainstorm occurred in Cincinnati, Ohio, about 10.45 A.M. on May 20, giving a precipitation of 2.31 in. in 38 minutes, according to the report of the local office of the Weather Bureau. This exceeds the precipitation of the storm of May 14, 1881, which was 1.14 in. in 20 minutes. The heaviest rainfalls in 24 hours were 2.98 in., May 25, 26, 1879; 2.47 in., May 27, 28, 1882, and 2.43 in., May 1, 1894. Since 1871 all the record storms have occurred in May, with the exception of 1897, when 1.99 in. fell during one hour on July 5.

An old oaken chair, which is said to be the most perfect specimen of ancient British carpentry extant, has been found by Dr. James Johnson in the village church at Stanford Bishop, Eng. It is believed to have been used by St. Augustine at the synods held between A.D. 590 and 603. The chair is made entirely of wood, without any form of iron work.

The proposal to develop the power of the great falls of the Zambesi River, in South Africa, is said now to be taking definite shape, the consulting engineers of the Rhodesia railways having been retained in connection with the development. These falls are the largest in the world, being larger even than Niagara. They are about a mile wide and 420 feet high, and even in dry seasons the water is from two to three feet deep at the crest of the falls. It is proposed to erect electrical transmission lines to cover the district within a radius of 150 miles, a distance which work at California has shown to be entirely practicable. In the territory covered by this radius the Wankie coal fields and some rich copper deposits are found, as well as all the materials necessary for the manufacture of calcium carbide.